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(74) Agents: WILLIAMS, Trevor, John et al.; J.A. Kemp & Co., 14 South Square, Gray's Inn, London WC1R 5EU (GB).

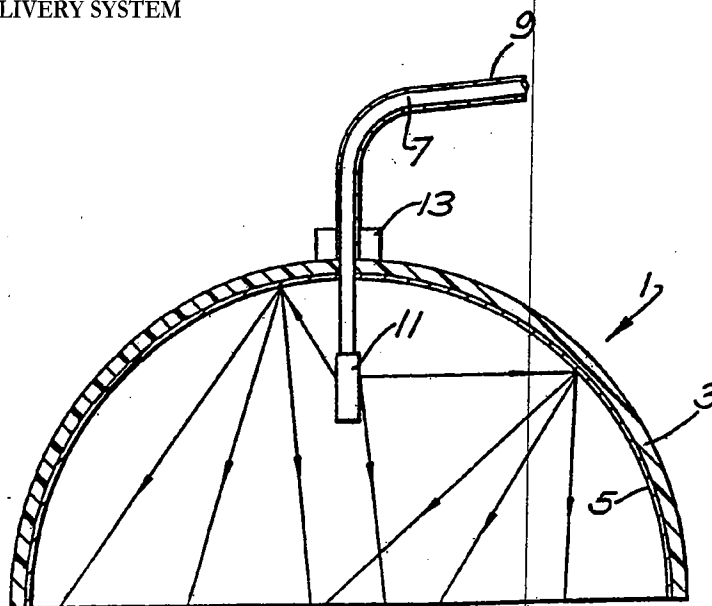
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(54) Title: LIGHT DELIVERY SYSTEM



(57) Abstract

A device for uniformly irradiating an area of a surface which accurately reflects lights reflected from the area and scatters it back towards the surface. The device comprises a hemispherical shell (3) whose inside surface is coated with a diffuse reflector and a light source (11) mounted in the shell (3). The light source may be a diffusing device connected to a laser remote from the shell (3) via an optical fibre (7). In use the shell (3) is placed against the surface under illumination so that the edges of the shell (3) define the area under illumination and the use of the diffusely reflecting surface of the shell (3) prevents any escape of light. A deformable sheet of partly reflective and partly transmissive material may be placed across the open mouth of the hemisphere to cover the target area to increase the uniformity of illumination when the device is used on uneven surfaces. The device is particularly useful in photodynamic therapy.

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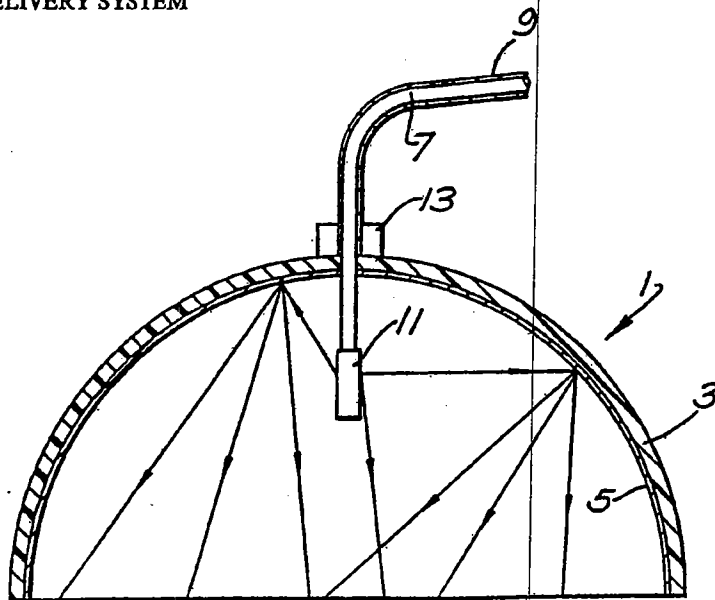
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LIGHT DELIVERY SYSTEM

This invention relates to an apparatus and method for illuminating an area of an object and in particular to a device in which the total amount of luminant energy delivered to the area can be accurately determined. It is particularly applicable to medical treatment techniques which rely on the illumination of body tissue in order to achieve desired effects e.g. photodynamic therapy and bio-stimulation.

It has been found that certain types of cancer including skin cancer and breast cancer can be treated successfully using a technique known as photodynamic therapy or PDT. In this technique a photosensitizing agent, usually haematoporphyrin derivative (HpD) is administered to the patient and this agent concentrates in the cancerous tissue. It is thought that the agent concentrates in the tumour because it leaks out of the vasculature in the tumour into the surrounding tumour tissue. The lymphatic system within the tumour is not as efficient at removing the HpD as is the lymphatic system in the rest of the body and so for a certain time period there is proportionately more HpD in the tumour than in the rest of the body. At some point in that time period the area of the body with the tumour is irradiated with laser light having a wavelength of about 630

nm! from! an! argon aye laser. '! The! effec of! the! laser! light  
on! the! OpD! is! to! cause! oxygen! radicals to! be! released! which  
destroy! the! surrounding! tumour! tissue. In! the! case! of  
breast! cancer! the! illumination! stage! o the! treatment is  
usually! given! twenty-four! to! seventy-two! hours! after  
administration! of! the! HpD! agent,! though with! skin! cancer,  
laser treatment! can! be delivered! up! to three! or! four! weeks  
after! the! administration! of! the! HpD.

Conventionally! the! treatment! a! ea! has! been  
illuminated! using! laser! light! directed down! an! optical  
fibre,! the! tip! of! the! fibre! being! moved over! the! treatment  
area. One! problem! with! this! method! is that! the! illumination  
consists! of! an! intense! centre! spot! with the! intensity  
falling! away! gradually! from! the! centre of! the! spot.! This  
means! that! it! is! difficult! to! give! an! even! dosage! of! light  
to! a! large! area\_! Furthermore,! it! is! vry! easy! to! apply! too  
much! light! to! some! areas.! In! order! to! attempt! to! alleviate  
this! problem! it! has! been! proposed! to! deliver! the! light! using  
an! optical! fibre! bundle! with! micro-lenses! on! the! end! of! each  
fibre! or! diffusers! in! the! light! path! to! give! a! broader,! more  
even,! illumination! 'area. Another! proposal! is! to! control! the  
intensity! profile! of! the! beam! emerging! from! an! optical! fibre  
by! interposing! an! oblique! glass! plate! between! the! laser! and  
the! optical! fibre.

A! further! problem,! which! also! occurs! with! the

-! 3! -

improved techniques mentioned above, **is**, however, that since the surface of the body being illuminated **is** to some extent reflective, it is difficult to determine exactly how much light is absorbed to act on the HpD. The reflectivity of different parts of the treatment area may vary and so even dosage estimates based on an estimated or measured reflectivity are not particularly good. A typical dosage estimate with one of the techniques above was that 30-400 J/cm<sup>2</sup> was delivered to the patient. It can be seen that the upper limit of the range is over ten times the lower limit and this is unsatisfactory both from the point of view of that treatment and for **statistically** processing the results from many treatments to try to improve the technique.

It has also been proposed to use laser light in other medical treatments, e.g. bio-stimulation in which tissue is irradiated with low power laser light. It has been suggested that this irradiation has certain beneficial effects and has been used to speed-up the healing of wounds, as a beauty treatment and in physiotherapy. Laser illumination has also been used in the treatment of vascular **abnormalities** such as port wine stain and the removal of tattoos. Other types of light **have** also been used, for instance, infra **red** or **ultra violet** for treating various conditions e.g. the treatment of skin disorders e.g. psoriasis. In some of these agents which render the **skin**


4! -

sensitive! to! the! particular! light! bein<sup>g</sup> used! have! been  
**administered** to! the **patient**. **However**, similar! problems! with  
achieving! a! uniform **illumination** and! calculating! the! amount  
of! light! delivered! to! the! surface! have! been! found.

The! present! invention! provides! a! device! to! deliver! a  
defined **quantity** of! light! to! a **surface! comprising** a! light  
source! for! illuminating! the! surface! and! means! for! scattering  
light! reflected! from! the! surface! so! that! it! can! be! directed  
back! onto! the! surface.! Preferably! the! scattering! means! are  
adapted! to! provide! ..a! substantially! uniform! illumination! of  
the! surface.

In! more! detail! the! present! invention! provides  
apparatus! for *illuminating* an! area! of! an! object,! comprising  
a! delivery! device! including! a! light! source! for! illuminating  
the! area! and! a! concave *diffusely* reflecting *surface*, wherein  
the! diffuse! reflecting! surface! is! adapted! to! define! the! area  
to! be! illuminated! when! the! device! is! held! in! contact! with  
the! object! and! to! collect! light! reflected! from! the! surface  
*of* the! object! and! scatter! it! back! towards! the! area.

Preferably! the! light! source,! which! conveniently! is  
the! tip! of! an! optical! fibre,! is! arranged! to! illuminate! the  
diffusely! reflective! surface! so! that! light! from! the! light  
source! is! reflected! towards! the! treatment! area.! This! can! be  
achieved! by! diffusing! the! light! with,! for! example, a ceramic  
reflector! or! possibly! a p.t.f.e.! or! etched! diffuser! on! the



-! 5! -

optical! fibre. |

The! present **invention** also! pro **ides! a** method! of  
illuminating! an! area! of! an! object! comp! ising! the! steps! of:

illuminating! the! area! of! the! o! ject! with! light! from  
a! light! source! illuminating! a **concave** iffusely! reflective  
**surface! maintained! confronting! the! are**

positioning! the! diffusely! refl! cting! surface! with  
its! edges! in! contact! with! the! objects! that! it! collects  
light! reflected! from! the! surface! of! th! object! and.! scatters  
it! back! towards! the! area! and! so! that! t! e! edges! of! the  
concave! diffusely! reflecting! surface! d! fine! the! area! being  
illuminated.

The! light! used! may! be! laser! li! ht! as! in! the  
conventional! PDT! techniques! or! may! be! on-coherent! light! for  
some! applications. The! diffusely! refl! ctive! surface! may! be  
**the** inner,! concave! surface! of a part-s 'nherical, e.g.  
hemispherical,! shell-like! structure! wi! h! the! optical! fibre  
and! diffusing! device! attached! in! its! t•p.! In! use,! the! shell  
is! held! with! its! edges! in! contact! with! the! object! under  
illumination! so! that! any! light! reflect! =d! off! the! illuminated  
area! is! collected **and! scattered! back t ere to! by** the  
diffusely! reflective! surface. A! refle•tivity! of! 99%! can! be  
achieved! by! coating! the! concave! surfac! with! reflective  
paint,! or! any! suitable! highly! reflecti! e! coating,! e..g.! a  
ceramic.



If the area to **be** illuminated is smaller than the base area of the hemisphere then parts of the area which do not **require illumination** can be masked with a highly **reflective surface**. This means that light striking the reflective surface is not lost **but** is reflected back towards the **diffusely reflective surface** and **eventually-onto** the area to be illuminated.

It will be appreciated that with the present invention the amount of light delivered to the treatment area can be accurately determined since none of the light delivered to the area is allowed to escape. This is because almost all of the light reflected from the illuminated area is scattered back towards it by the diffusely reflective surface and since the reflective surface is held in contact with the object, no light can escape under the edges. Furthermore, the use of a diffusing device on the end of the optical fibre delivering the laser light and the use of the diffusely reflective surface mean that the intensity of the illumination is **substantially** uniform over the whole of the treatment area.

The invention also has benefit for the safety of the operator and, if it is being used in medical treatment, for the patient, as once the reflective surface is in contact with the body the laser system is closed and there is very little risk of accidental injury to the operator or

to! the! patient! caused! by! escaping! las! r! light.! It! is possible! to! arrange! for! the! laser! or! cther! light! source! only to! be! switched! on! when! the! reflective! surface! is! placed! in contact! with! the **body!** - e.g.! by! a! pressure! sensitive! or temperature **sensitive! switch! or** by! some **other** switching means.

If! desired! the! target! to! be! illuminated! may! be treated! with! an! agent! to! absorb! the! light.! e.g.! a **photodegradable** or! photocensitizing! agent.! For! example where! the! invention! is! to! be! used! in! photodynamic! therapy, e.g.! for! the! treatment! of! cancer,! then! a! suitable! agent which! might! be! preferentially! absorbed! by! certain! cells! e.g. cancerous! cells,! e.g. *HpD* can! be! administered! to! the! patient some! hours! before! the! laser! treatment.! An! accurate! amount of! light! can! then! be! delivered **to** the! treatment! area! and this! allows! the! operator! to! calculate! more! accurately! what depth! of! tissue! may! be! destroyed.! This! not! only! allows better! treatment **of** an **individual** pati! nt! but! also **allows** a better! correlation-! of! results! to! treat! ent! conditions! and! so the! best! conditions! for! the! treatment! f! the! cancer! and different! types **of** cancer! may! be! determined! more! easily.

The! invention! is! also! useful! fr! the! treatment! of port! wine! stains, **homeopathic** processe! and! bio-stimulation where! the! fact **that** the **illumination** i uniform **and! defined** allow! better! control! of! the! treatment 'rocess.

-! 8! -

The! invention! has! been! describ  
to! use! in! medical! treatment,! e.g.! for-  
It! is,! however,! useful! in **any** process  
to! uniformly! illuminate! an! area! and! to  
by! reflection! from! that! area.! Thus! th  
in! industrial! processes! for! manufactur  
substances! e.g.! plastic! resin! composit  
processes! in! the! manufacture! of! electr  
microchips. In! such! processes! the! fac  
escapes! and! that! a well! defined! area! i  
that! the! process! can! be! run! economical  
processes! types! of! electromagnetic! rad  
optical! laser! light! might! be! appropria

The! device! may! also! be! useful  
biological! growth! of **animals** ox! partic  
again! the! fact! that! the! illumination! i  
and! no! radiation! is! allowed! to! escape  
efficiency! and! economy! of! the! process.

The! shape! of! the! reflective! su face! is! not! thought  
to! be! particularly! critical,! the! prefer **red! embodiment! in**  
this! specification! uses! a! hemisphere! bu **t! other! concave**  
shapes! can! be! used.

The! size! of! shell! is! chosen! to be close! to! the! size  
of! the! area! to! be! illuminated.

A! typical! size! of! shell! used! for! medical! purposes

d! above! in! relation  
hotodynamic! therapy.  
here! it! is! desirable  
avoid! losing! light  
device! could! be! used ,  
e.g.! for! curing  
s! or! for! optical  
nic! devices! e.g.  
that! no! light  
illuminated! mean  
y. Clearly! for! such  
ation! other! than  
e.

or! promoting  
larly! plants,! where  
accurately! defined  
an! improve! the

-! 9! -

would be a few inches in diameter, but **larger or smaller**  
shells, e.g. large enough to cover the **complete pelvic area,**  
may also be used where appropriate. I **is also possible for**  
the reflective surface to be formed on **a flexible** member so  
that it can be **shaped** to match the shape of the area to be  
**treated. These allow the operator to void** treating areas  
which do not need treatment.

As an alternative to using a diffusing device on the  
end of the optical fibre, the fibre may be mounted to direct  
light onto a diffuse reflector, made from, e.g. a reflective  
ceramic, mounted in front of the diffusely reflective  
surface to reflect the light back onto it.

The apparatus may further comprise a deformable  
sheet of material across the open end of the concave  
surface, e.g. a sheet of white rubber or synthetic rubber,  
and which has a high reflectivity, appreciable transmission  
and low-absorption. The absorption should be low enough to  
prevent undesirable light loss, e.g. about 1%, and the  
transmission high enough to allow sufficient illumination of  
the target surface. For medical applications about 9% is  
acceptable. The reflectivity should be for such  
**applications, about 90%.**

The **invention** will be **further** described **by** way of  
**non-limitative example** with reference to the **accompanying**  
drawings which: -

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Figure 1 is a cross-sectional view of one embodiment of the invention;

Figure 2 is a partially cutaway view of the embodiment of Fig 1 in use;

Figure 3 is a schematic view of a second embodiment of the invention in use;

Figure 4 shows a third embodiment of the present invention; and

Figure 5 shows a fourth embodiment of the invention

As can be seen by Fig 1 the apparatus comprises a light delivery device 1 which consists of a hemispherical relatively rigid, plastics shell 3 whose inside, concave surface is coated with a reflective coating 5. The coating is a reflective paint or ceramic which provides a diffuse reflective surface. It is possible to achieve a reflectivity as high as 99% or more with such a coating. The shell, intended for medical use in PDT is about 5-15cm in diameter and about 1-2mm thick.

Laser light is supplied to the device along an optical fibre 7, which may be a single fibre or a bundle of fibres. In this embodiment the fibres are teflon coated and retained within a p.t.f.e. sheath 9. The fibres terminate at a diffusing element 11, which is in this embodiment a p.t.f.e. cylinder or, alternatively, a ceramic or etched fibre diffuser (formed by exposure to hydrofluoric acid)

11! -

mounted in the **hemispherical** shell. The fibre is connected to the shell by a two-part block 13 having a bore *down* the centre through which the fibre and sheath pass. **The fibre** is trapped in an interference fit between the two parts of the block 13. In the illustrated embodiment the diffuser 11 is positioned about 2cm below the top of the shell. Light transmitted down the fibre passes into the diffuser 11 and is emitted from the end **of** the diffuser in a number of directions. Some light will be transmitted directly to the treatment surface, but some light **will** also be transmitted towards the diffusely reflective surface 5. Various light paths are shown in the diagram. Light striking the diffusely reflective surface will be scattered therefrom, partly towards the treatment area and partly towards opposing regions of the reflector. It will be appreciated, therefore, that a fairly uniform illumination is achieved within the region defined by the edges of the reflective shell.

Although not shown in the diagram, the shell may be provided with a sensor and switch so that the laser supplying light to the optical fibre is only switched on when the shell is pressed into contact with the surface which is to be illuminated. This results *in* less chance of the patient or operator being accidentally exposed to laser light and thus improves the safety of the apparatus.

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In Fig. 2 the device is shown schematically in use on part of a patient 15. This shows the device used in a situation where the area 17 which is to be illuminated is **smaller than the base area of the reflector**. The **parts of skin which would undesirably be exposed to the light have therefore been masked using a reflective tape 19, -for example, aluminium tape**. This means that light supplied to the delivery device 11 which misses the **exposed treatment area** and hits the tape is reflected back up to the **diffusely reflective surface** and scattered back towards the treatment area.

Figure 3 shows a second embodiment of the invention in use. In this embodiment the reflective shell 22 is formed from a flexible plastics material so that it may be deformed to cover a desired treatment area more accurately. A further feature of this embodiment, which can also be used in the other embodiments of the invention, is that light is supplied to the device by several optical fibres 27 **each** connected to a diffusing device 11 and spaced over the surface of the shell. This enables a greater amount of light to be delivered per unit time if necessary and helps in maintaining a substantially uniform light distribution **particularly** in the case where the shell is deformed.

The above embodiments have been described as being supplied with laser light by an optical fibre. However, the

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invention is! also usable in! other applications! in! which! e.g. ultra! violet! or! infra! red! light! or! any! electromagnetic! wave radiation! are! used.! in! such! applications! the! light! may! be delivered! to! the! delivery! device! using! a! light! guide! e.g. liquid! or! fibre! light! guide! or! other! t! pes! of! radiation guides! or! the! light! source! may! be! moun! ed! in! or! on! the shell.

Figure 4! shows! schematically a! third! embodiment of the invention in! which! light delivered to! the *device by* an optical! fibre! 9! is! directed! onto! a! ref! ector! 30! in! this! case spherical,! though! other! shapes! may! be! sed,! which! reflects light! back! upon! to! the! diffusely! refle! tive! surface! which, in! turn,! scatters! it! onto! the! treatmen! area.! The! reflector 30,! which! may! be! a! highly! reflective! c! ramic,! is! mounted! on the! shell! 1! by! a! mounting! 32.

Figure! 5! shows! disgrammaticall! a! fourth! embodiment of! the! invention! which! uses! a! reflecto! 1! and! light! delivery system! 9! and! 30! as! in! the! previous! emb•diments,! but! also includes! a! deformable! partly! reflectiv=! partly! transmissive sheet! 50! across! the! open! end! of! the! reflector! which,! in use,! covers! the! target! area.! The! sheer! 50! may! be! a! sheet! of white! rubber! or! synthetic! rubber! and! h-s! a! high! reflectance preferably! greater! than! 17%! and! more! p! eferably! still greater! than! 77%! ,! very! low! absorttion! •referably! less! than 5%! and! appreciable! transmission. Typi.al! values! which! have



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been! **effective** in! practice! are,! for! in! tance, . 90%  
reflection, 9% transmission *and* 1% absorption.! This! sheet  
50! is **particularly** useful! when! the! dev! ce! is! used! to  
illuminate! an **uneven! surface! as** it! con orms! or! **partly**  
**confirms to that! surface! and! improves** she! uniformity! of! the  
**light! delivered! to! the! target.**

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With! the *invention* it! is! possitle! to! calculate! the  
amount! of! light! supplied! to! the! treatment! area! much! more  
accurately! than! with! the! prior! art! devices.! This **is** because  
**substantially** all! of! the! light! supplied! to! the! device! is  
eventually! absorbed! by! the! treatment! surface.! None! is  
allowed! to! escape! -! because! the! reflector! shell! is! placed! in  
contact! with! the! object! being! illuminated! and! any! light  
reflected! from! the! treatment! surface! is **eventually** scattered  
back! by! the! diffuse! reflector! towards! t! e! treatment! surface.  
Furthermore,! the! fact,! that! virtually! n! ne! of! the! light  
supplied! to! the! device! is! allowed! to! es! ape! means! that! the  
device! is! particularly! safe! to! use.

While! the! invention! has! been! de! cribed! in! relation  
to! the! medical! treatments,! as! discussed! above! it! is  
applicable! wherever! it! is! required! to! deliver! an! accurate  
and! uniform! irradiation! to! a! surface,! or! to! substantially! .  
reduce! the! amount! of! light! lost! from! a! system,! or! to! define  
the **area** to! which **radiation! should! be! delivered.** The! effect  
**of! this! device! in! minimizing! losses! has** benefits! in! that! for

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a! given! total! energy! absorption! requir! ment! for! a! given  
power! output! of! the! radiation! source,! less! time! will! be  
needed! to! bring! about! that! effect.

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CLAIMS

1. **Apparatus to deliver a defined quantity of light to a surface comprising a light source for illuminating the surface and means for scattering light reflected from the surface so that it can be directed back onto the surface.**

2. **Apparatus according to claim 1 wherein the scattering means are adapted to provide a substantially uniform illumination of the surface.**

3. **Apparatus for illuminating an area of an object, comprising a delivery device including a light source for illuminating the area and a concave diffusely reflecting surface, wherein the diffusely reflective surface is adapted to define the area to be illuminated when the device is held in contact with the object and to collect light reflected from the surface of the object and scatter it back towards the area.**

4. **Apparatus according to claim 3 wherein the light source is adapted to illuminate the diffusely reflective surface so that light from the light source is scattered towards the area of the object.**

5. **Apparatus according to claim 3 or 4 wherein the light source is a source of laser light**

6. **Apparatus according to claim 3, 4 or 5 wherein**

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the! light! source! includes! an! element! for! distributing! the  
light! onto! the! reflecting! surface.

7. Apparatus! according! to! cl! im! 6! wherein! the  
element! is! a! diffusely! reflecting! body

8. Apparatus! according! to! claim! 6! wherein! the  
element! is! a! p.t.f.e.! cylinder.

9. Apparatus according! to! an! one! of! the! preceding  
claims! wherein! the! diffusely! reflectiv! surface! is! the  
concave! surface! of! a! shell-like! struct! re,! the! edges! of! the  
shell! defining! the! area! to! be! illuminated! when! it! is! held! in  
contact! with! the! object.

10. Apparatus! according! to! claim! 9! wherein! the  
concave! surface! is! coated! with! a! reflective! ceramic! to! form  
the! diffusely! relect.ive! surface.

11. Apparatus! according! to! anj one! or! the! claims! 3  
to! 10! further! comprising! a! deformable heet! of! material  
across! the! open-end! of! the! concave! surf ace,! said! material  
**having! a** high! light! reflectance, **apprec** iable! light  
transmission! and! low! light! absorption! flor! the! light! from  
**said** light! source.

12. A! method! of! illuminating! an! area **of** an! object  
comprising! the! steps! of:

**illuminating** the! area! of! the! object! with! light! from  
a! light! source! preferably! a! laser! light! source,! illuminating  
a! concave! diffusely! reflective! surface! maintained

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confronting! the! area,

and! positioning! the! diffusely! efecting! surface  
with! its! edges! in! contact! with! the! object! so! that! it  
collects! light! reflected! from! the! surf-ce! of! the! object! and  
scatters! it! back! towards! the! area! and! o! that! the! edges! of  
the! concave! diffusely! reflecting! surfa! e! define! the! area  
being *illuminated*.

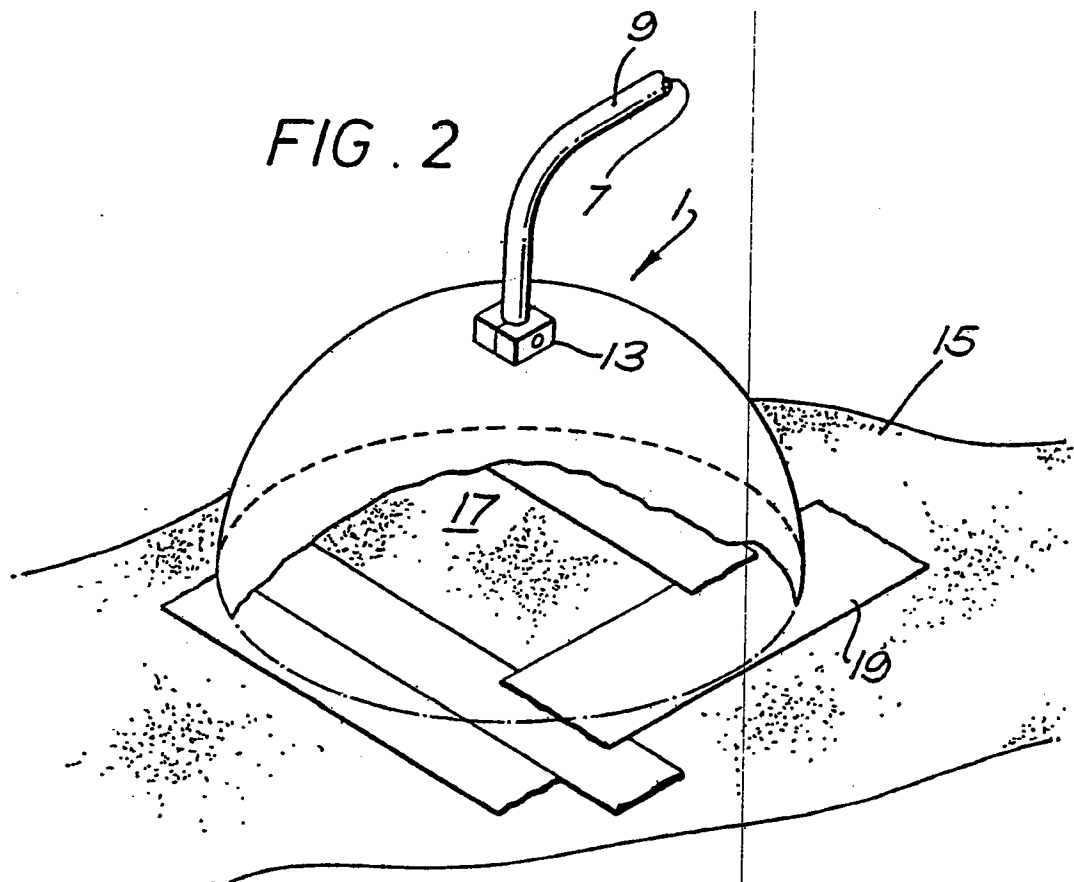
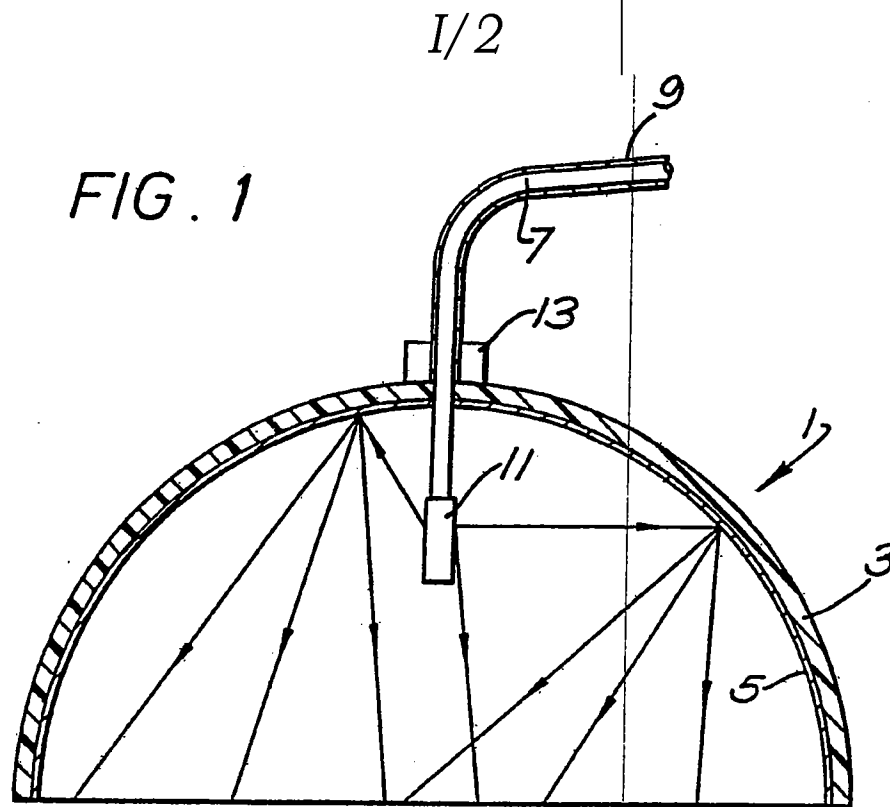
b

13. A! method! according! to! cia 12! wherein! the  
diffusely! reflecting! surface! is! illumi! ated! by! light  
delivered! by! an! optical! fibre! to! a! dif! user,! e.g.! of! ceramic  
or! a! p.t.f.e.! cylinder,

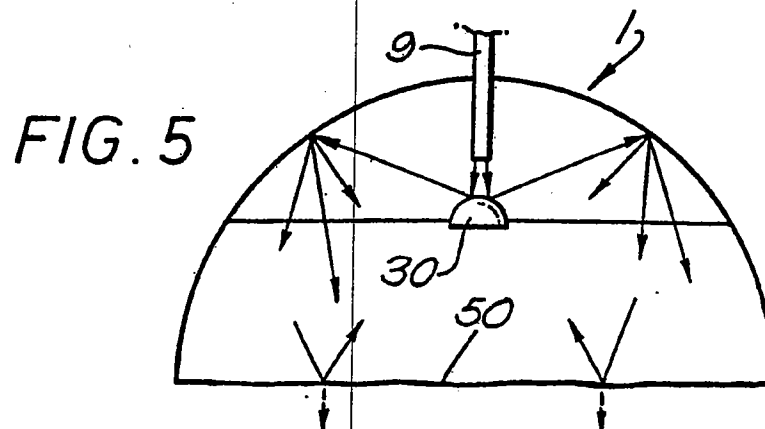
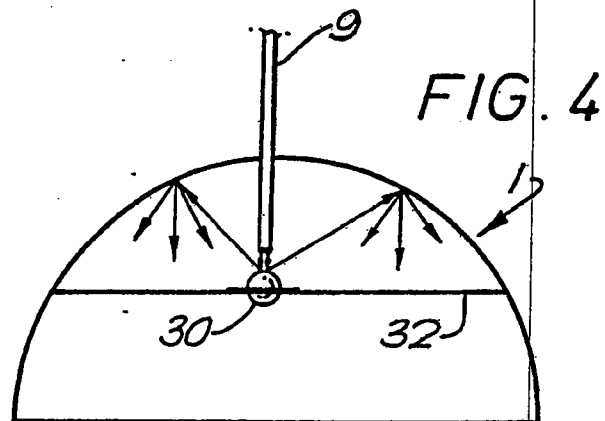
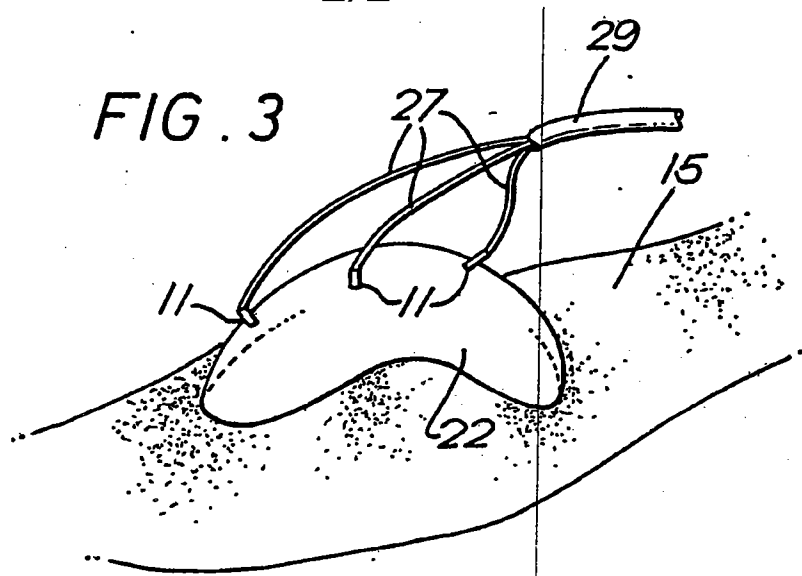
14. A! method! according! to! claim! 12! or! 13! wherein  
the! area! is! provided! of! with! a! degradable! agent! for  
absorbing! the! light.

15. A! method! according! to! cla 12,13! or! 14,  
wherein! light! from! the! concave! surface! is! transmitted  
through! a! deformable! sheet! covering! th! surface,! the! sheet  
having! properties! of! high! light! reflec! ance,! appreciable  
light! transmission! and! low! light! absor! tion.

||



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# INTERNATIONAL SEARCH REPORT

International Application No. PCT/GB 89/00796

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) <sup>r</sup>			
According to International Patent Classification (IPC) or to both National Classification and IPC			
Ipc5: A 61 N 5/06			
ii. FIELDS SEARCHED			
Minimum Documentation Searched <sup>7</sup>			
Classification System		Classification Symbols	
IPC5		A 61 N, A 61 B	
Documentation Searched other than Minimum Documentation to the extent that such Documents are Included in the Fields Searched <sup>8</sup>			
iii. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup>			
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with Indication where appropriate of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	
X	FR, A 2591902 (COLLIN) 26 June 1987, see page 3, lines 28-32; page 6, figure 4 --	1-5, 9, 12	
X	D.E, A 3300517 (MERSMANN) 26 July 1984, see page 9, lines 12-20; page 52, lines 32-37; page 99, lines 9-33; figures 93-96	1-10, 12	
<p>Special categories of cited documents: <sup>14</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"L" document which may throw doubts on priority claims or which is cited to establish the publication date of another citation or for other special reasons (as specified)</p> <p>"O" document referring to an oral disclosure, user, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document cited to show that the invention is not novel</p> <p>"Y" document cited to show that the invention is not inventive</p> <p>"3" document cited to show that the invention is not new</p>			
<p>men published after the international filing date and not in conflict with the application but understood the principle of the theory underlying the</p> <p>of particular relevance; the claimed invention considered novel or cannot be considered to involve a</p> <p>of particular relevance; the claimed invention considered to involve an inventive step when the is combined with one or more other such documents combination being obvious to a person skilled</p> <p>member of the same patent family</p>			
IV. CLERIFICATION			
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report		
18th October 1989	3 Oct 1989		
International Searching Authority	Signature of Authorised Person		
EUROPEAN PATENT OFFICE	T.K. WILLI		



ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.

GB 8900796  
SA 30105

This annex lists the patent family members relating to the patent documents cited in th<sup>1</sup> above-mentioned international search report.  
The members are as contained in the European Patent Office EDP file on 08/11/89  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family members)	Publication date
FR--A- 2591902 -----	26-06-87	None	-----
'DE-A- 330(1517	26-07-84	None	